UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/657,465	09/08/2003	Shirish Dnyaneshware Bahirat	STL11291	9791

7590 04/12/2005

David K. Lucente
Seagate Technology LLC
Intellectual Property - COL2LGL
389 Disc Drive
Longmont, CO 80503

EXAMINER	
SLAVITT, MITCHELL R	

ART UNIT	PAPER NUMBER
2651	

DATE MAILED: 04/12/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/657,465	BAHIRAT, SHIRISH DNYANESHWARE	
	Examiner	Art Unit	
	Mitchell R Slavitt	2651	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *08 September 2003*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-26* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,10,11 and 20-22* is/are rejected.

7)☒ Claim(s) *2-9,12-19 and 23-26* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *09 August 2003* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *8/9/03*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

2. Claims 1, 10-11, and 20 are rejected under 35 U.S.C. 102(a) as being anticipated by White et al. (White).

Regarding claims 1 and 11, receiving a resonant frequency of an apparatus as an input. See 1st sentence of the Abstract. The apparatus being a sensor and the frequency from the output of the sensor and is the input going into a digital filter. Calculating a set of coefficients of a notch filter wherein the notch filter has a notch frequency that is approximately equal to the resonant frequency. See claims 4 and 7 in cols 10-11. White teaches in claim 4 a first and second coefficient. In claim 7, dependent on claim 4, a third and fourth coefficient are taught. Also see the penultimate sentence in the Abstract where White states the filter tunes the notch frequency to align with the resonant frequency. Using fixed-point arithmetic. See col 4, lines 43-52, last sentence. Programming the digital filter. See col 3, lines 64-67. A notch filter that attenuates the resonant frequency. See col 1, lines 10-14. In claim 11, the movable assembly susceptible to resonant frequency is described at col 1, lines 15-39. Control circuitry that controls the movable assembly as described in the example of an

emergency generator can be found in a host computer controlling the operations of an emergency generator.

Regarding claims 10 and 20, Fig 4 teaches a digital notch filter.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 21-22 are rejected under 35 U.S.C. 103(a) as being unpatentable over White in view of Lane et al. (Lane).

Regarding claim 21, White teaches receiving a desired notch frequency as input, calculating a set of notch filter coefficients using fixed-point arithmetic, writing a set of notch filter coefficients, and a notch filter that attenuates the resonant frequency, as stated in response to claims 1 and 11. White does not expressly teach one processor, memory, and set of instructions in memory. Lane teaches these features at col 4, lines 24-28 (processor), col 8, lines 10-12 (memory), and col 8, lines 14-18 (instructions). At the time of the invention it would have been obvious to one of ordinary skill in the art to modify the teaching of White with the inclusion of a processor, memory, and instructions that are commonly used with a digital filter.

Regarding claim 22, Lane further teaches the processing of other functions that can be implemented simultaneously on the DSP. See col 4, lines 24-28.

Allowable Subject Matter

5. Claims 2-9, 12-19, and 23-26 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Conclusion

6. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Mitchell R Slavitt whose telephone number is (571) 272-7562. The examiner can normally be reached on M-F (6:30-4:00), 2nd Friday off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, David R Hudspeth can be reached on (571) 272-7843. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

DAVID HUDSPETH
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2600

MS
4/6/05

Fixed-point Arithmetic

by Paul Field

Floating-point numbers allow you to deal with an extremely wide range of numbers: from the very small to the very large. They do this by storing the number as some digits and the position of the decimal point. For example, 19,000,000 could be stored as (19,6) and 0.00019 as (19,-5). However, if you don't have a floating-point co-processor, this sort of arithmetic can be slow. If you're prepared to lose the wide range of numbers that floating-point gives, you can speed things up by fixing the position of the decimal point and using integer arithmetic operations. This is called fixed-point arithmetic.

In this article we're going to use fixed-point decimal numbers because they make the examples simpler. We'll see how the ideas apply to binary at the end. We're going to store numbers to two decimal places so we turn the "real" number into an integer by multiplying by 100. For example, the number 5 will be stored as 500 and the number 2.01 as 201.

How do we add these numbers? Easy, integer addition is fixed-point addition. For example, *201 + 201 = 402*, which corresponds to *2.01 + 2.01 = 4.02*. Subtraction is the same.

What about multiplication? Let's try *201 x 201 = 40401*. Because the two operands are 100 times the "real" numbers, the result is 10000 times the "real" result (*100a x 100b = 10000ab*). To get the proper fixed-point result (i.e. only 100 times the "real" result) we can divide this answer by 100: *(201 x 201) / 100 = 404* which corresponds to *2.01 x 2.01 = 4.04*.

Unfortunately, there's an upper limit (LONG_MAX) on the integers we can use and the fixed-point multiplication tends to generate a large intermediate result. If our operands are of similar sizes, we'll have an upper limit of $\sqrt{\text{LONG\_MAX}}$ for representing fixed-point numbers. Can we do the multiplication without this limitation?

Instead of dividing by 100 *after* the multiplication, we can divide each of the operands by 10 (since *ab/100 = a/10 x b/10*). Let's try: *201/10 x 201/10 = 20 x 20 = 400*. Remember that division is integer division, so we've lost some accuracy. Can we get it back?

Think of the numbers as consisting of two parts added together. The first part is a multiple of 10, so integer division by 10 is precise, and the second part is the remainder. So, 201 would be *200 + 1*. If we write the numbers as $a + a'$ and $b + b'$, we can write the fixed-point multiplication algebraically and rearrange it:

$$\frac{(a + a')(b + b')}{100} = \frac{ab + a'b + ab' + a'b'}{100} = \frac{a}{10}\frac{b}{10} + \frac{a'}{10}\frac{b}{10} + \frac{a}{10}\frac{b'}{10} + \frac{a'}{10}\frac{b'}{10}$$

The first term is our inaccurate multiplication; the remaining three terms give us back the accuracy. As it stands, we can't use the equation because a' and b' are less than 10 so the integer division will produce 0. We can re-arrange so that these divisions happen after the multiplication:

$$\frac{a}{10}\frac{b}{10} + \left(a'\frac{b}{10}\right)\Big/10 + \left(\frac{a}{10}b'\right)\Big/10 + \frac{a'b'}{100}$$

a' and b' are less than 10 so the the last term must be less than 0.81 ($9^2/100$), so for a tiny degree of

inaccuracy in the last digit, we need only use the first three terms.

This article has shown decimal examples because they are more familiar for us humans. However, you can use any number as the "scale factor" for fixed-point numbers: simply substitute n for 100 and $\sqrt{n}$ for 10 in the equations above for the general form. For a computer implementation, you should pick n and $\sqrt{n}$ so they are powers of 2 (e.g. 2^{24} and 2^{12}) so that the divisions can be performed using bit shifts and the calculation of a' and b' can be performed by and-ing with a mask. The code for this was included on last month's disc and, incidentally, Acorn's compiler turns the multiplication code into what I believe is the optimal machine code.

This article and accompanying code should give you enough information to implement super-fast Julia and Mandelbrot set programs in C. Other fixed-point operations (such as division) may be needed by other applications but they are beyond the scope of this article.

From CAUGers volume 2 issue 6  Comments to caug@accu.org